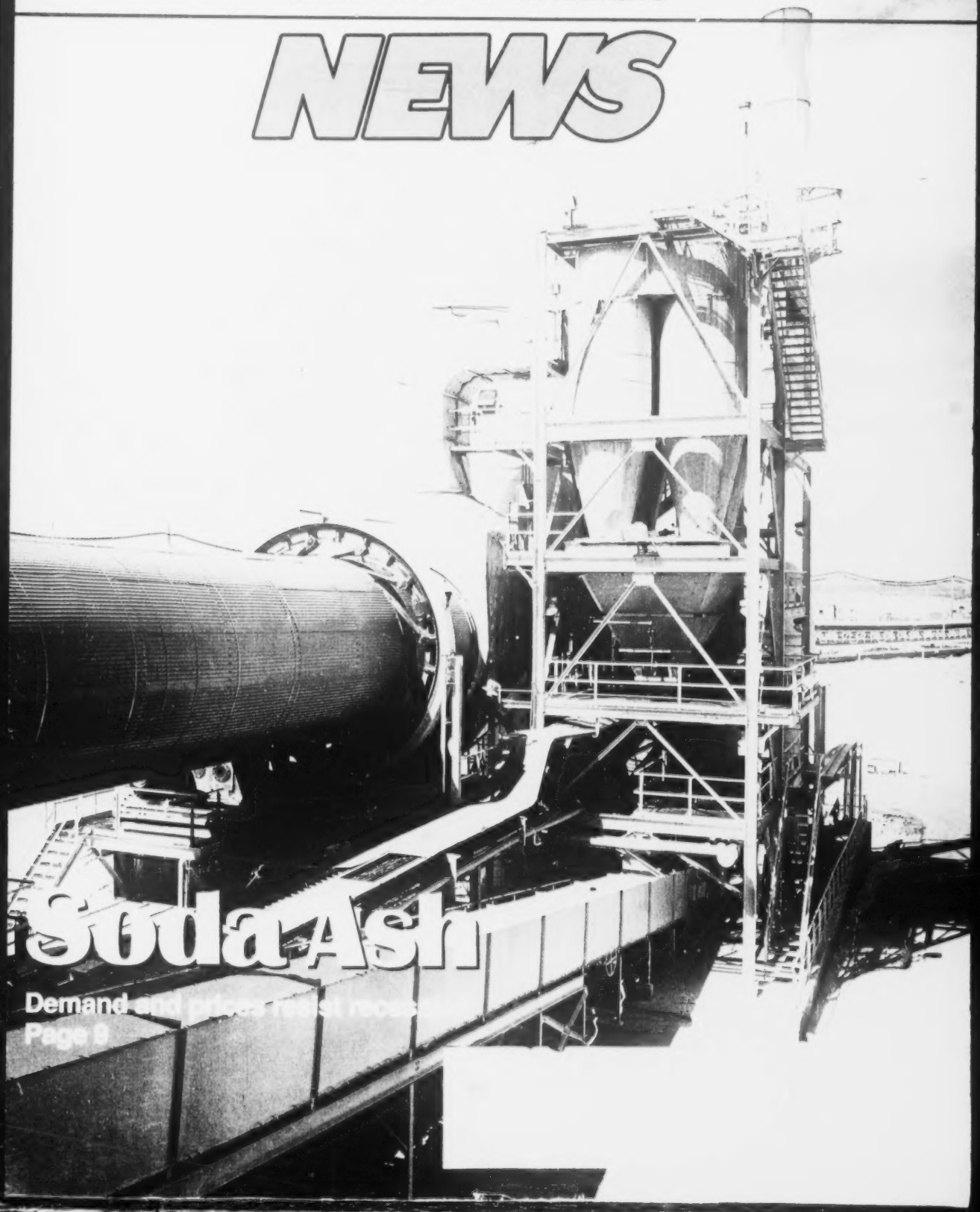
OCTOBER 28, 1991
CHEMICAL & ENGINEERING

NEWS



Soda Ash

Demand and prices rise at record pace

Page 9

CHEMICAL & ENGINEERING
NEWS
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News of the Week

■ **New scientific assessment finds global ozone losses accelerating, leads to call for stronger restrictions on man-made chlorine compounds.** **Page 4**

■ **Federal appeals court strikes down EPA ban on most remaining uses of asbestos.** **Page 5**

■ **National Research Council panel blasts Superfund and its failure to assess health-related effects of hazardous-waste sites.** **Page 5**

■ **German study of pesticide plant workers exposed to high levels of TCDD finds significant increase in deaths from cancer, supporting findings of previous U.S. study.** **Page 6**

■ **Chemical industry still shows effects of recession, as earnings at many firms continue to drop in third quarter.** **Page 6**

Cover: Rotary calciner at FMC's Green River, Wyo., facility converts trona ore to impure soda ash

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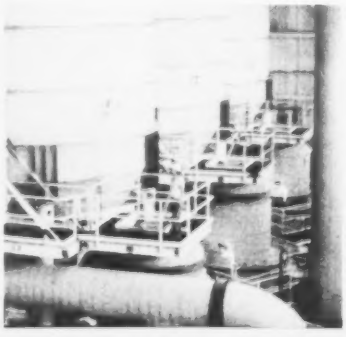

Cover Story

Demand for soda ash will be down slightly this year as a result of recession, but is forecast to bounce back in 1992, thanks in large part to increasing export business. **Page 9**

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LETTERS

Promoting science

Much has been written recently on the need to promote science to high school students and on the usefulness of the ACS SEED program pertaining to minorities. However, readers may believe that the SEED program is applicable only to universities and colleges.

It is true that virtually all of the students are hosted by universities and colleges, but that does not mean that industry cannot participate also. On the contrary, industry can benefit greatly while helping worthy students.

We at Unilever Research U.S. enjoyed the company and help of two excellent SEED students this summer. The students learned a lot and we profited from their hands-on help in the laboratory. Obviously, the work they carried out cannot be discussed openly like university research, but they can talk about techniques they have learned and a general description of the work carried out.

I would urge my colleagues in industry to participate in the program. The pleasure on the faces of the students is reward enough.

Allan H. Gilbert
Special Assistant to the President
Unilever, Edgewater, N.J.

Adversary relationship

The disagreement between D. Allan Bromley and Office of Management & Budget (OMB) director Richard G. Darman (C&EN, Sept. 16, page 4) is an ideological one, reflecting the White House's long-time adversary position vis-à-vis business, which has characterized many administrations. To this has been added the Bush Administration's free-market and budget-busting attitudes.

My own experience as an adviser in the Kennedy round of trade negotiations (as chairman of the Synthetic Organic Chemical Manufacturers Association's International Commercial Relations Committee) revealed the adversary relationship that existed then. Whereas we were held at arms length, major British and German chemical manufacturers literally told their negotiators what positions to take.

Currently, OMB attempted to reduce physicians' reimbursement by $7 billion, contrary to the legislative history of the Relative Value Scale enacted by Congress. Since this was a breach of faith, 90,000 to 100,000 angry letters from physicians caused Congress to hold fast and not agree with OMB.

It is hoped, in the interest of focusing public attention on critical technologies, that scientists and engineers will mount a similar campaign for the planned institute's appropriation. The paltry $5 million requested is peanuts compared to the savings and loan scandals. It is important for government and industry to work together effectively. I hope your readers will respond. Global competition requires that our government assist in reducing to practice the fundamental discoveries we are now developing before our trading partners take advantage of them.

Ernest M. May
Summit, N.J.

Organic compounds in glass

In light of the recent "discovery" of the lubricating properties of boric oxide and subsequent debunking by A. J. Byer, (C&EN, July 22, page 3), it seems appropriate to comment on the report of the "inclusion of organic compounds in glass for the first time" written in the cover story (C&EN, May 27, page 24).

In fact, the inclusion of complex organic molecules in solid glass was described at least as early as 1948 (Kasha, M., *J. Opt. Soc. Am.*, **38**, 1068) and has been described in a variety of glasses, including hydroborates and hydrosilicates, zinc and alkali phosphates, and tin fluorides, to name a few. The concept was patented for solid glasses in 1983 (Paul A. Tick, U.S. Patent no. 4,379,070) and the concepts of fluorescence and phosphorescence, photochemistry and optical nonlinearity demonstrated [Tick, Paul A. et al., *J. Opt. Soc. Am.*, **4**, 1030 (1987)].

The inclusion of organic compounds in porous glasses, which is considerably easier to accomplish, was described in the 1960s. Xerogels are one member of a group of inorganic porous glasses and are not unique in the realm of porous glasses [Brinker, C. Jeffrey, Scherer,

Continued on page 47

Correction

• Oct. 21, page 23: The units for wastewater pollutants shown in the table are lb per day, not millions of lb.

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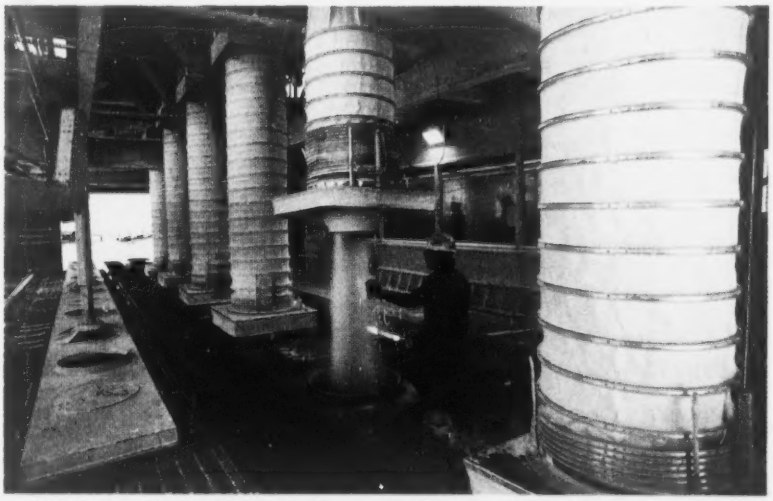
Demand for Soda Ash Holding Up Well During Recession

Consumption of commodity will slip only slightly this year and is expected to rebound in 1992, aided largely by strong growth in exports

Bruce F. Greek, C&EN Houston



Worker samples soda ash as railcar is loaded at Tenneco's Green River plant

Making and selling soda ash has become one of the most recession-resistant segments of the chemical industry. Plants currently are being operated near optimum capacity, and demand, which is expected to be down only slightly from last year, is forecast to rebound in 1992, aided by export growth. What's more, prices are holding up, although they're discounted as usual. And capacity is continuing to be expanded.

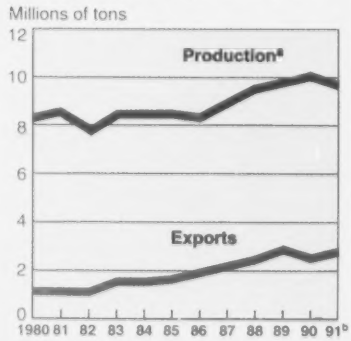
Nevertheless, soda ash remains far from the rapid-growth commodity that typifies many organic chemicals, such as some plastics. Globally, the two dominant soda ash markets—glass and chemicals—either meet strong competition from other materials or meet environmental and economic constraints, which tend to reduce use. However, environmental factors are strongly aiding growth of some smaller uses of soda ash, such as flue-gas treating and processing in the pulp and paper industry.

Despite competition from other materials and the efforts to reduce consumption in major uses such as glass containers, soda ash demand in the U.S., including exports, will continue to grow. According to Roger E. Shamel, president of Consulting Resources in Lexington, Mass., soda ash use will grow on average close to 3% per year through 1995. Production of soda ash, closely tied to demand, likely will fall to about 9.9 million tons this year from the record output of 10.1 million tons in 1990. Next year's expected recovery in demand, which may already be under way, likely will easily put soda ash back on its growth curve for the first half of the decade.

Global demand for soda ash also will keep growing, says Richard J. Regan, vice president of soda ash marketing for General Chemical, Parsippany, N.J. He estimates that long-term growth will average 1.5 to 2% annually, from a 1991 global demand of 32.5 million tons. More than two thirds of this demand will be supplied by synthetic soda ash manufactured outside the U.S. This year about 500,000 tons of natural soda ash will be produced from sources outside the U.S.

In the near term synthetic soda ash poses strong competition with U.S. exports of natural soda ash, according to several industry sources. Removal of the large antidumping duty ($67 per ton) in 1990 against U.S. soda ash going to Western Europe will continue to help export shipments near term. Longer term, energy and environmental costs of making synthetic soda ash in areas such as Eastern Europe could lead to the closure of old plants using the synthetic, or Solvay, process based

Soda ash output sags as exports move up this year



a Synthetic and natural soda ash combined prior to 1987. b Estimate. **Sources:** Bureau of Mines, Department of Commerce

on salt and limestone. Reduced output of synthetic soda ash for regional sales could further open new markets to U.S.-supplied natural soda ash.

U.S. demand for soda ash has slipped this year because of recession-related declines in glass sales, especially flat glass, which is used in automobiles and commercial buildings. Exports, however, continued to grow this year and are expected to total about 2.8 million tons, or 29% of the 1991 production.

Although demand for soda ash will decline slightly in 1991, plants will be operated at an average of more than 90% of their design capacity this year. Inventories of soda ash normally are low because of the high cost of storage relative to a list price of $98 per ton. Much of the inventory exists as material in railcars in transit. As a result, demand, rather than inventory building and reduction, causes the major changes in the level of plant operation.

Rising demand for soda ash will be met by a continual series of capacity expansions, says Shamel. By 1995, when demand could reach 12 million tons per year, announced additions will add 1.4 million tons to total annual capacity. Unannounced plant debottlenecking easily could add the remainder of capacity needed to meet demand during the next five years.

While total demand for soda ash is increasing slowly, its pattern is undergoing more rampant change. Notable changes over the past two decades have been in the shares of consumption by the two largest segments of U.S. demand—glass and exports. Glass has lost share of consumption, and exports have gained.

In 1980, glass containers in the U.S. accounted for about 40% of demand for soda ash, says William L. Breunig, venture director for FMC's alkali division. In 1990, containers probably required only about 20% of U.S. soda ash demand.

Three major developments have affected demand for soda ash in making glass containers, says Richard L. Hogan, vice president of marketing for Tenneco Minerals. The most significant has been the replacement of glass containers by plastics. The greatest impact was the commercialization of the 2-L soft-drink bottle, although the shift to plastic bottles for various foods and alcoholic beverages also has reduced use of soda ash. Although major shifts from glass containers may be complete, minor replacement by plastics likely will continue.

Another development has been the rapid growth of recycled glass,

Resurgence of the lime-soda process

Manufacture of caustic soda (sodium hydroxide) without the coproduct chlorine has been surging, reviving the nearly two-centuries-old lime-soda process. Rising caustic soda selling prices and the continuing high cost of electrolytic caustic soda are prompting producers to seek a lower cost way to meet increasing demands for caustic.

Renewed use of the lime-soda process is being spurred indirectly by environmental concerns about the byproducts from use of chlorine as a bleaching agent in pulp and paper manufacture and about the use of various chlorine compounds as solvents and chemical intermediates. Chlorine demand in these and other uses is expected to decline during this decade. Following recently lowered demand, chlorine prices have declined, causing an increased share of the cost for electrolysis of brine to fall on caustic.

Recent sporadic use of the lime-soda process in the U.S. began in 1988, when chlorine demand had weakened so much that caustic soda prices had to be increased steeply to cover more of the costs of making an electrochemical unit (roughly 1.1 lb of caustic soda and 1 lb chlorine) by electrolysis of sodium chloride brine. The recession also lowered chlorine demand and dropped selling prices to below $100 per ton. In contrast, caustic prices now are above $300 per ton on the spot market, despite demand being weaker than a year ago.

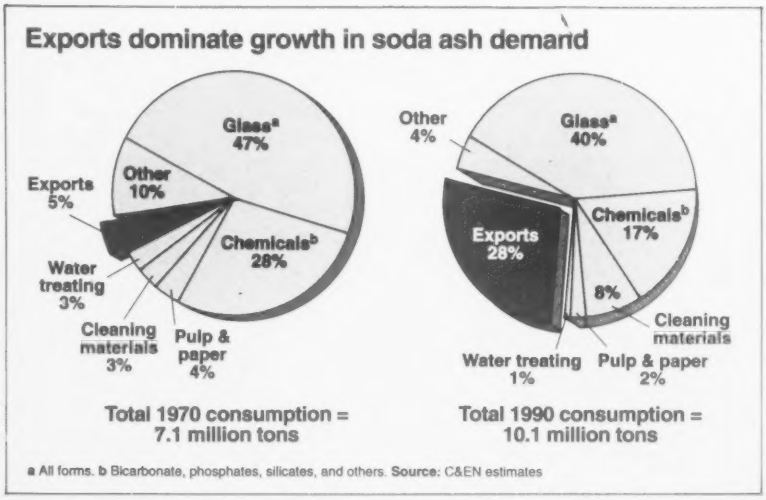
The lime-soda process is based on simple inorganic chemistry. When added to sodium carbonate in solution, lime (calcium oxide) becomes slaked lime (calcium hydroxide), which then reacts to form caustic soda (sodium hydroxide) and calcium carbonate that precipitates. The reaction can be driven by removal of the calcium carbonate through filtration. Cost of the process is reduced by using solution-mined soda ash, such as is done by FMC, or by using mine waters containing soda ash, as done by Tenneco Minerals and expected to be done by other companies starting in 1992.

In most instances, the caustic solution is concentrated by multiple-effect evaporation to 50%, leaving the form of caustic most often sold commercially. The lime value can be recovered by calcining in a kiln. If a low-cost source of lime is available, the calcium carbonate may be discarded as a less expensive option than the investment in and operating costs of a kiln.

Currently, the lime-soda process for caustic is being used on a significant commercial scale only in the Green River, Wyo., area, where most production of natural soda ash occurs. Some of the output is used at the site to make other derivatives. Cost for shipping a 50% solution reduces the area for distribution when competing with electrolytic caustic. Small-scale, on-site manufacture of caustic using shipped-in dry soda ash is not competitive with electrolytic caustic if costs of recovery of the lime value or disposal of the calcium carbonate are included.

Both the lime-soda process and the process to make soda ash synthetically (by the Solvay process or its derivatives) were developed for small-scale commercial use about the turn of the 19th century, and both involve calcium carbonate. In making synthetic soda ash, sodium chloride and calcium carbonate are reacted to make sodium carbonate, lime, calcium chloride, and carbon dioxide. Ammonia and water are involved in intermediate steps of the overall reaction and are then recycled.

As in the lime-soda process, a disposal problem results from the synthetic soda ash process. This coproduct calcium chloride presents an even greater disposal problem than the coproduct calcium carbonate of the lime-soda process. As a result, U.S. companies produce only natural soda ash.



called cullet. Use of cullet is driven by both environmental concerns and the economics of glass-making. As recycling accelerates, the amount of cullet grows, its quality improves, and its cost goes down, points out Shamel. The quality requirements for flat glass generally limit cullet use to waste glass made on site. Container glass, however, may be made of as much as 50% outside recycled cullet. Some small quantities of recycled cullet also are used in making glass fiber. Recycled cullet probably will continue reducing use of soda ash through the 1990s.

Downsizing or "lightweighting" of containers is another factor cutting demand for soda ash in glass. Reducing glass container weight aims at being more competitive with plastics in shipping costs as well as saving glass. How much more weight reduction of glass containers can be achieved is uncertain, but lightweighting is expected to have a minor effect on future soda ash demand.

Offsetting some of these losses in soda ash use, some companies continue to develop new glass products and new applications for glass containers, says Regan. Examples include the wide range of cookware for use in microwave ovens and the rapid growth in "wine cooler" beverages.

U.S. demand for soda ash in making chemicals—another large market—has remained nearly constant during the 1980s but lost share of total demand as exports' share rose. Soda ash competes with caustic soda for many chemical uses. For certain applications, only one of these alkalies can be used. But for many, substitution is possible. Now, when caustic soda prices are unusually high, soda ash is being substituted where process and handling characteristics allow. That substitution could add 1 to 2% annually to demand for soda ash, industry sources say.

Substitution for caustic could hold soda ash demand for use in chemicals fairly steady, even as demand for some sodium chemicals decreases. Demand for several sodium phosphates is declining, especially sodium tripolyphosphate that goes into detergent formulations, because of more restrictions on use of phosphates in various parts of the U.S. Gains in other small uses of sodium phosphates are not likely to offset the decline in detergents.

Sodium silicates, bicarbonate, and chromate account for most of the other chemicals made from soda ash. Silicate demand fluctuates as detergent formulations change, and as demand changes for various kinds of catalysts, pigments, and other industrial products. Outlook for the bicarbonate may hinge on development of flue-gas treating methods. Demand for most of the chromium compounds made from sodium chromate is expected to be flat. As a group, chemical uses of soda ash probably will not grow much, and the percentage of total soda ash use for making chemicals is likely to decline.

Cleaning products consumed about 8% of soda ash last year. Soda ash is put into detergents and other cleaners to act as a builder, a buffering agent, and a diluent. Changes in formulations of these products can affect demand for soda ash. The average annual growth for this use is about the same as for cleaning materials in general, which is about 2% annually.

Pulp and paper manufacture once required more than 250,000 tons of soda ash annually. By 1982, this use was down to 60,000 tons per year. Because of the high price of caustic, this use has resurged and may reach 150,000 tons this year. But after the resurgence, demand will grow more slowly because the many mills that have facilities to use soda ash will have switched to soda ash.

A large number of other uses account for less than 10% of soda ash demand. They range across most industries, including textiles, foods, metal processing, and flue-gas treating. Demand for soda ash in these uses, possibly spurred by environmental regulations, could grow more than the average because of new developments in a diverse group of businesses.

Use of soda ash in flue-gas treating, for example, continues to depend on response to the Clean Air Act amendments and on competition from other materials selected to remove sulfur dioxide from flue gases. In general, soda ash proves more effective in wet scrubbing of flue gas, but wet scrubbing is more capital intensive and thus is used more in new installations. In dry scrubbing, ores such as trona and nacolite are used as dry sodium sorbents in preference to soda ash for converting sulfur dioxide to sodium sulfate. Despite the concerns over acid rain, industry sources forecast modest growth for soda ash for the near term in this use.

With all of the varied uses, soda ash stands out as a premier example of a mature commodity chemical. Although growth in demand for soda ash will be slow, it will happen. As a result, soda ash can be expected to remain as stable in an economic downturn as it has this year. □